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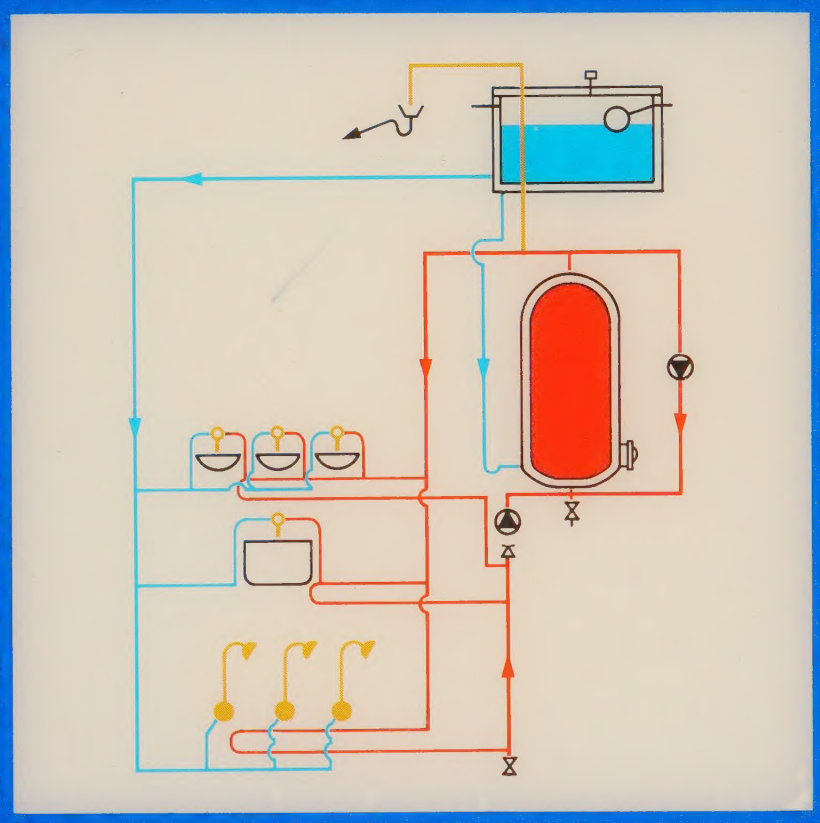
Health Technical Memorandum 2027

Operational management

Hot and cold water supply, storage and mains services



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Operational management

Hot and cold water supply, storage and mains services

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About this publication

Health Technical Memorandum (HTM) 2027 provides recommendations, advice and guidance on the design, installation and maintenance of hot and cold water distribution systems in healthcare premises. It is applicable to new and existing sites, and is for use at various stages during the inception, design, upgrading, refurbishment, extension and maintenance of a building.

HTM 2027 focuses on the:

a. legal and mandatory requirements;

b. design of systems;

c. maintenance of systems;

d. operation of systems.

It is published as four separate volumes, each addressing a specialist discipline:

a. **Management policy** – details the overall responsibility of managers of healthcare premises and their legal obligations in setting up and operating a reliable water supply, storage and distribution system. It summarises the technical aspects involved;

b. **Design considerations** – does not set out to give instruction in design work but highlights the overall requirements and considerations that should be applied to the design up to the contract document;

c. **Validation and verification** – details the requirements for ensuring that the supply, storage and distribution system is formally tested and certified as to contract and manufactured to the highest level of quality assurance. The importance of commissioning is emphasised and the minimum of tests on site are listed;

d. this volume – **Operational management –** provides information for those responsible for overseeing and operating day-to-day running and maintenance. Safe systems of work, record-

keeping and legal obligations are included.

Guidance in this Health Technical Memorandum is complemented by the library of National Health Service Model Engineering Specifications. Users of the guidance are advised to refer to the relevant specifications.

The contents of this Health Technical Memorandum in terms of management policy, operational policy and technical guidance are endorsed by:

a. the Welsh Office for the NHS in Wales;

b. the Health and Personal Social Services Management Executive in Northern Ireland;

c. the National Health Service in Scotland Management Executive;

and they set standards consistent with Departmental Cost Allowance Guides.

This HTM was written with the advice and assistance of experts in the NHS and industry.

References to legislation appearing in the main text of this guidance apply in England and Wales. Where references differ for Scotland and/or Northern Ireland, these are given in marginal notes.

Where appropriate, marginal notes are also used to amplify the text.

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1.0 Introduction

1.1 This volume outlines the principles involved in the operational management of the hot and cold water supply and distribution systems for healthcare premises. It includes cold water storage cisterns, hot water storage cylinders and heat exchangers, together with water treatment and pressurisation units, pipework systems and circulation pumps. This volume will apply to all healthcare premises, but some deviation may become necessary where the differing requirements for the various water undertakings must be met. Distribution design in healthcare premises may vary, as for instance in system building hospital manuals for cold water services systems, but the principles laid down in this memorandum should be observed.

1.2 Although many of its recommendations will be applicable, this document does not set out to cover fire-fighting services, nor water supply for industrial or other specialist purposes, other than to indicate precautions that should be taken when these are used in association with other water services. The point at which a domestic activity becomes an industrial process, for example in food preparation, has not been defined, and the applicability will need to be considered in each case.

1.3 As well as complying with the recommendations outlined in this document, any work relating to the operational management of the hot and cold water services, new or extended, in any healthcare premises should also comply with:

a. the current model water byelaws of the local water undertaking;

b. BS6700: 1987, the British Standard specification for design, installation, testing and maintenance of services supplying water for domestic use within buildings and their curtilage.

1.4 In 1989 new water byelaws came into effect and these are set out, along with the water industry's interpretation of these provisions, in the 'Water Supply Byelaws Guide 1989'. The WRc (Water Research Centre) operates the Evaluation and Testing Centre which provides advice on byelaws on a national basis and administers the Water Byelaws Scheme which tests and lists water fittings and materials for compliance with the byelaws. The 'Water Fittings and Materials Directory' contains information on suitable fittings and materials and is updated every six months.

1.5 It is required that any persons proposing to carry out works on cold water distribution systems liaise closely with the water undertaking.

1.6 Where existing facilities do not meet the standards recommended in this memorandum, management should carry out a risk assessment to establish the extent and priority of action required for compliance. Action must then be taken to meet these recommendations.

1.7 Whilst some guidance on the water services applications mentioned below is given in this memorandum, it is not intended to cover them fully:

laundries – see Health Building Note 25;

sterile supply departments – see Health Building Note 13;

hydrotherapy pools – see Public Health Laboratory service booklet 'Hygiene for Hydrotherapy Pools'.

Definitions

1.8 Definitions of terms are as those contained in BS6100 Sections 2.7 and 3.3, BS6700 and the Model Water Byelaws.

2.0 Operational considerations

2.1 There are three fundamental reasons for carrying out maintenance: legal, operational and economic.

Legal

2.2 Complying with the law is generally given the highest priority and is often seen as the minimum requirement that must be satisfied. The Model Water Byelaws prohibit the installation or use of any fitting which might cause waste, contamination or undue consumption of the water supply. There are also laws concerned with health and safety such as the Health and Safety at Work etc Act, the COSHH regulations etc. Functional testing of equipment must be carried out to ensure that it will operate when required, such as the testing of safety valves on calorifiers. Maintenance work should be carried out in an approved and safe manner.

Operational

2.3 Maintenance is undertaken to ensure the continuing, satisfactory and availability of services for staff and patients.

Economic

2.4 This maintenance work is associated with ensuring that the required efficiency is obtained from the plant and that the plant achieves its optimum economic life.

2.5 In order to decide the appropriate level of maintenance (for example scheduled, corrective or condition-based) for the different items of plant, the following questions must be addressed:

a. is the breakdown of a particular service going to prove critical during normal working hours or outside normal hours?;

b. how long can a breakdown of particular plant be tolerated?;

c. what cost can be justified to avoid breakdown of particular plant such as standby pumps?

2.6 The answers to the above questions will set the objectives for the maintenance policy. If response to failure is critical for certain items of plant, the maintenance organisation will require a planned strategy of calling out skilled staff to achieve an agreed response time and to minimise the interval between breakdown and the diagnosis and repair of the plant.

3.0 Cold water systems

Sources of water supply

3.1 The source of water supply may be either from a connection to the water undertaker's distribution supply system or from a private supply.

3.2 Private water supplies will principally be from local boreholes since other sources such as rivers, springs etc are unlikely to be economically viable as a source of supply for potable water.

3.3 It is the responsibility of the National Rivers Authority (NRA) to ensure that water resources are managed effectively. The NRA fulfils this role principally through the use of a system of water abstraction licences. Any organisation wishing to draw significant quantities of water from a surface or underground source must obtain a licence to do so from the NRA.

Water treatment

3.4 The need for water treatment and the method of application depend on the purposes for which the water is to be used and the quantity required for each purpose. Whilst potability is not normally affected by such characteristics as hardness, colour, and (within limits) smell and/or taste, a measure of treatment may be necessary to provide a more acceptable and wholesome supply.

3.5 A supply from a water undertaker should not normally require any further treatment when used for healthcare premises purposes other than for processing for laundries, domestic hot water systems and steam boiler feed water, where either the degree of hardness proves excessive or exceptional softness causes corrosion. Most private supplies, however, require some measure of treatment, and in many cases the installation of pumping and treatment plant needs to be extensive to ensure a constant acceptable quality.

3.6 Chemical conditioning systems which are used in conjunction with potable water systems should be selected very carefully. Addition of any substance must not cause a breach of any requirements in the Water Supply (Water Quality) Regulations 1989 (as amended), and any system for introducing a substance must be listed in the current edition of the Water Fittings and Materials Directory.

Northern Ireland: Equivalent provisions are proposed for Northern Ireland (Oct 93)

Scotland: The Water Supply (Water Quality) (Scotland) Regulations 1990 with amendments

3.7 Automatic water treatment systems should be fail-safe and have sufficient instrumentation to monitor their operation. Where automatic equipment is used for disinfection it should indicate any change in the amount or concentration delivered into the water. For example, ultra-violet (UV) systems should incorporate a UV detector so that any loss of transmission can be acted upon immediately.

Metal contamination

3.8 Analytical results have shown that there can be a serious problem from lead contamination of hospital water supplies. The 1993 edition of the World Health Organisation 'Guidelines for drinking-water quality' has lowered its guideline value for lead, from 0.05 mg/*l* to 0.01 mg/*l*. The WHO guidelines value is likely to be exceeded if lead pipes are present, or if copper pipes have been joined with solder containing lead. In general terms if hospital drinking water contains more than 0.05 mg/*l* of lead then remedial action should be considered.

3.9 Copper concentrations above 1 mg/*l* may cause staining of laundry and sanitary ware, and increase the corrosion of galvanised iron and steel fittings. Whilst the maximum allowable copper concentration in drinking water is 3.0 mg/*l* most supplies will give a level at the tap of less than 1.0 mg/*l*.

3.10 Water supplies to certain units such as maternity, neo-natal, paediatric, general paediatric and renal dialysis units must not be contaminated by copper or heavy metals in excess of 0.05 mg/*l*. The aluminium content of such water supplies should also be monitored to ensure that levels are below acceptable limits.

3.11 Where the water supply is known to dissolve metals, regular sampling tests should be made at strategic sampling points to ascertain that the level of metal contamination in the water supply to the healthcare premises, plus any added during its passage through the healthcare premises distribution system, does not result in limits above the stated safe levels. This will especially apply if the healthcare premises distribution pipework includes a multiplicity of leaded solder capillary joints. In soft water areas, metal contamination can occur by simple dissolution. Pitting corrosion arising in hard water areas, as a result of deleterious carbonaceous films laid down during the manufacturing process, does not normally give rise to elevated copper levels in the water and is not nowadays a problem if third party certified tubes to BS2871 Part 1 are used.

Filtration

3.12 Filtration of potable water to a particle size of 0.2 microns is not uncommon, typically using "dead-end" filters or cross-flow membrane filters.

3.13 In all cases it is feasible for bacteria to colonise or "grow through" the filter material even where backwashing is a feature. It is essential for filter cartridge elements to be changed at appropriate intervals in accordance with the manufacturer's recommendations, taking into account local conditions. Filter membranes should also be chemically cleaned or replaced at the recommended periods, and care must be taken to ensure that the "vessel" or "housing" containing the filter assembly is also disinfected appropriately during filter or membrane maintenance.

Water softening

3.14 Hard waters are sometimes unsuitable for many industrial and domestic purposes. Treatment may therefore be necessary to remove or alter the constituents to render the water suitable for particular purposes.

3.15 Base exchange softening removes permanent and temporary hardness from water. The technique uses an ion exchange process in which the calcium and magnesium ions in solution are removed and replaced by an equivalent amount of sodium ions.

3.16 Daily or frequent backwashing and periodic cleaning and disinfection (six-monthly) must be undertaken in accordance with the manufacturer's/supplier's instructions which may require using chlorine (20 mg/*l*). Other proprietary cleaning agents are not recommended, particularly if the softened supply water serves apparatus such as dialysis units.

3.17 Other water softening methods include physical water conditioning and magnetic water conditioning. The operation and maintenance of these systems should be in accordance with manufacturer's instructions.

3.18 Further information on water softening can be found in BSRIA Applications Guide AG 2/93 'Water Treatment for Building Services Systems'.

Disinfection

3.19 Normally a supply from a water undertaker should not require disinfection, but all piping, fittings and associated services used for the conveyance of water for domestic purposes must be disinfected before being brought into use. Such piping, fittings and storage cisterns must also be disinfected on completion of works which have entailed "opening up" the system. Private water supplies must be disinfected before being used for domestic purposes. Disinfection is effected by chemical or physical agents; the method generally used is chlorination.

Additional advice on the use of an alternative disinfectant, in Scotland, is given in 'Domestic hot and cold water systems for Scottish health care premises' SHTN 2

3.20 Disinfection using chlorine should be carried out in accordance with the guidance given in the 'Validation and verification' volume of this HTM, and under the direct supervision of a nominated person.

3.21 The continuous chlorination of hot and cold water service systems to control the growth of legionellae is not recommended unless it is suspected that they are the source of cases of hospital-acquired legionella infection.

3.22 Contaminated water that is run to waste into a natural watercourse, or a drain leading to it, should be treated in accordance with the requirements of the authority responsible for land drainage and pollution control. The authority responsible for that sewer should be informed. Dechlorination can be achieved using either sulphur dioxide or sodium thiosulphate. 20g of sodium thiosulphate crystals are required to dechlorinate 500 litres of water containing 20 mg/*l* free chlorine.

Water storage

3.23 The quality of stored water needs to be preserved to avoid microbial contamination and other loss of quality. Special attention should be given to all cisterns, tanks or other devices used to store water. It is necessary to minimise stagnation and stratification of the stored water. A maximum of 12 hours' total on-site storage capacity is recommended. The quantity of water stored should be carefully assessed in relation to the daily requirement in order that a reasonable rate of turnover is achieved. Storage of unnecessarily large quantities of potable water will result in low rates of turnover and a consequent deterioration in the quality of water. The storage capacity should be reduced where it is known or established that it is excessive and where it is practicable to do so; an example would be where there are two cisterns in parallel, one of which can be left empty and blanked-off (pipe sections should be removed). Alternatively, the steady water level in the cisterns should be lowered; this can be achieved easily if the float controlling the water supply has a thumbscrew adjustment as prescribed in BS1212:Part 1. The design capacity should not allow for future extensions. Pipework connections to and from the storage systems should be arranged to encourage good circulation within the system.

3.24 Delayed action float operated valves may help to ensure that stagnation is reduced.

3.25 Storage cisterns should be located to minimise heat gains. To restrict microbiological growth it is important that the temperature of stored water is kept as low as practicable, ideally not more than 20°C.

3.26 Every cistern must be provided with a properly-fitting cover and any pipe open to the atmosphere, for example the overflow, must be properly screened as required by the water byelaws. A sketch illustrating general potable water storage cistern requirements is contained in Figure 1.

3.27 All cold water storage cisterns and cold feed cisterns must be regularly examined–those containing less than 1000 l at least every 12 months and those containing more than 1000 l at least every six months, paying particular attention to the presence of foreign objects, biological material and excessive corrosion. On completion of the examinations the cisterns should be cleaned and any remedial work carried out. Before the cisterns and system are put back into use they should be disinfected in accordance with the procedure detailed in the 'Validation and verification' volume of this HTM.

3.28 Any chemicals used in the cleaning or maintenance of cisterns must be of a type considered acceptable for potable water use.

3.29 Where potable water has been stored in an inadequately protected cistern a water analysis should be considered. In multiple cistern installations a check should be carried out for stagnant water, usually apparent by odour or a dusty surface. If this is found to be the case the cisterns should be flushed out and the inlet and outlet connections rearranged so that flow is sequential and the problem does not recur.

3.30 Cistern insulation should be checked to ensure that it is in good condition and adequately positioned.

3.31 Float operated valves should be checked to ensure that they are securely fixed and set to achieve a correct water level in accordance with the water byelaws.

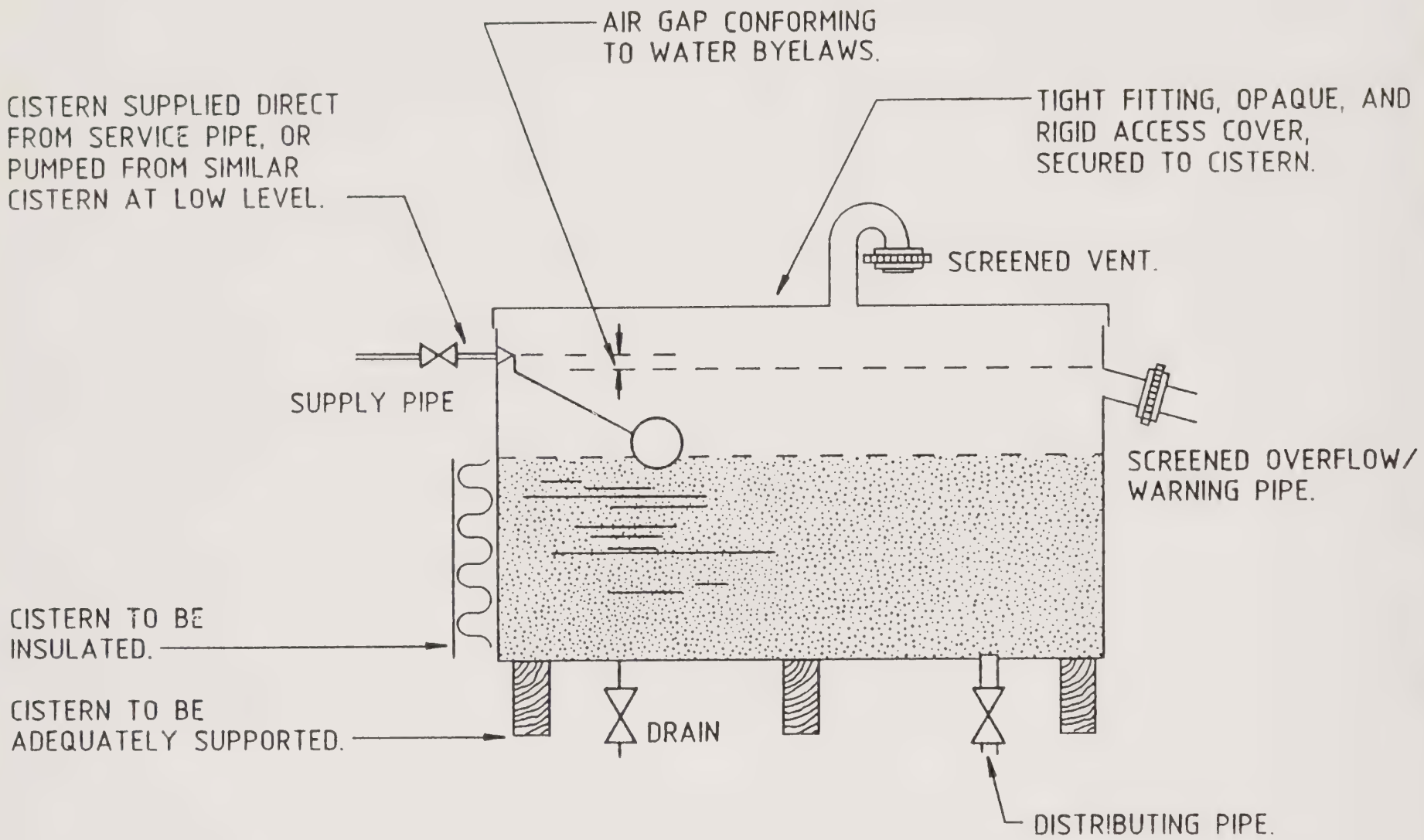
3.32 Overflow/warning pipes should be checked to ensure that they do not rise in level and they are clear and correctly routed to give an obvious visual alarm of an overflow condition. A weatherproof label fixed adjacent to the warning pipe, identifying the tank and its location together with the person/department to be contacted in the event of a discharge, would contribute to a quick and accurate defect report which could then be acted upon, so minimising water wastage.

3.33 A schematic drawing, illustrating piping and valve arrangements for break tank operation during normal running and maintenance periods is included in Figure 2 of this volume.

Pressurisation/supply pumps

3.34 Where two or more pumps are installed for pressurising systems, automatic control should be provided to sequence the pumps to ensure that each pump is regularly brought into service (at least daily) as the main duty or lead pump, in order to minimise any danger of stagnation.

3.35 The maintenance carried out on this type of equipment should be in accordance with the manufacturer's recommendations.

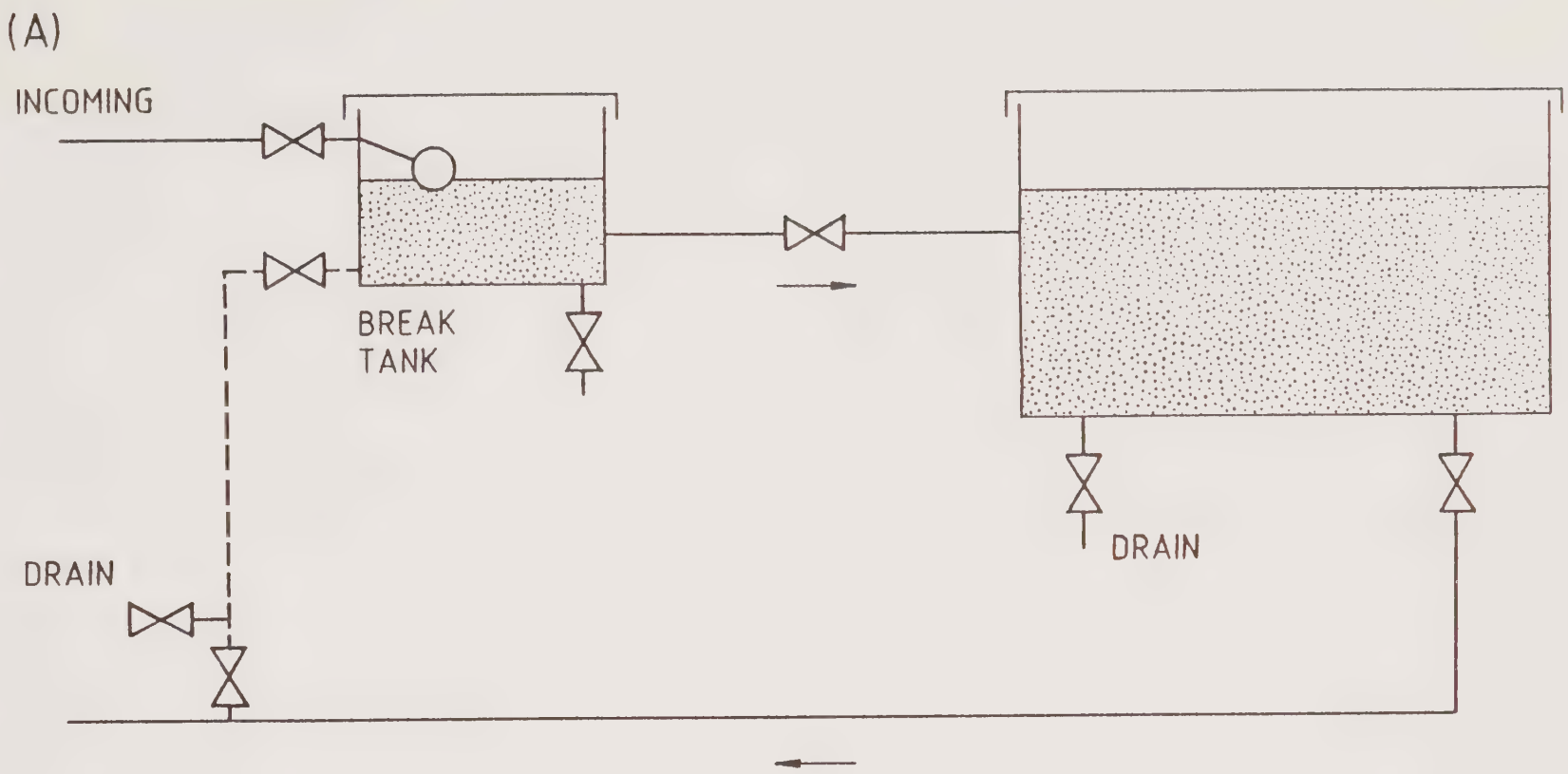


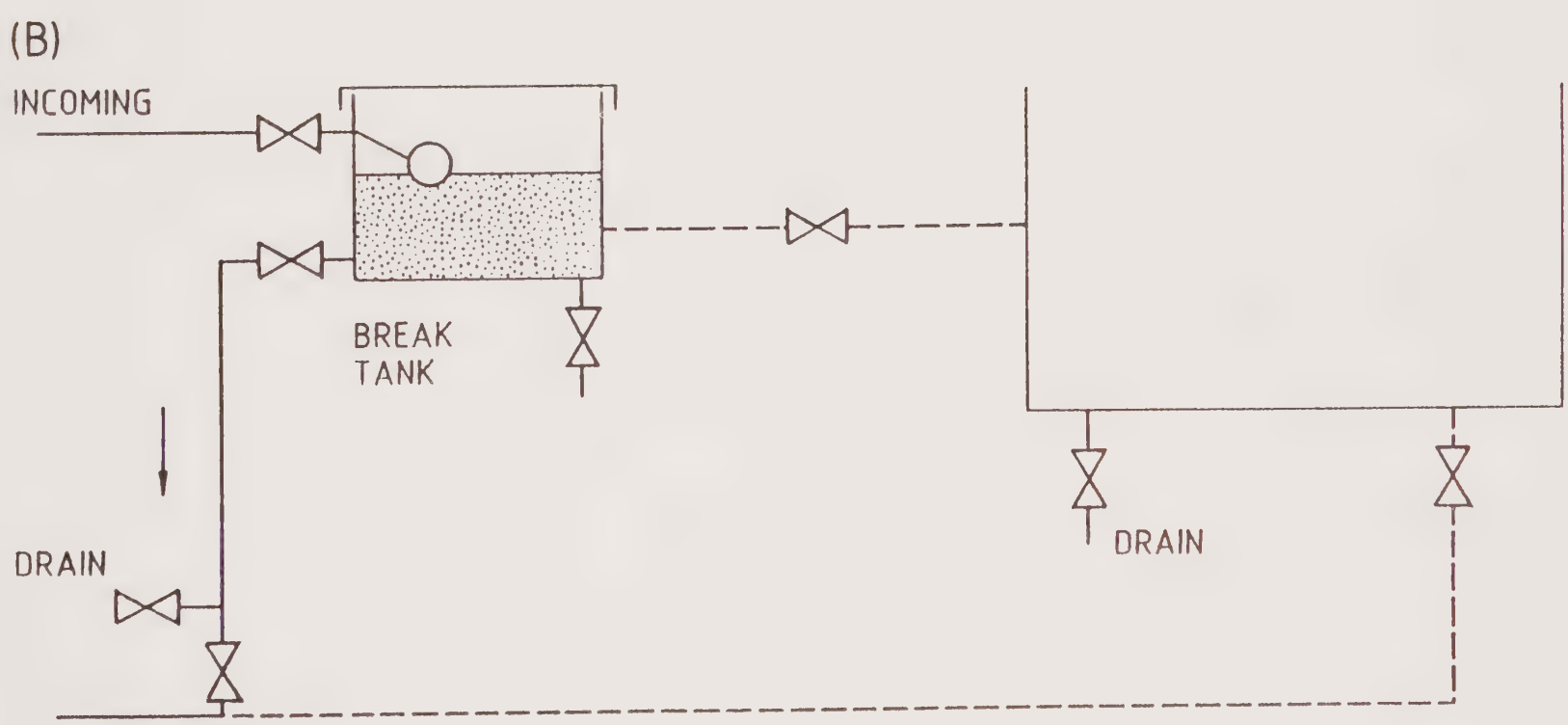
NOTE :

CISTERNS SHOULD BE SITUATED AWAY FROM HEAT SOURCES.
ACCESS SHOULD BE PROVIDED FOR INSPECTION AND MAINTENANCE (BOTH INTERNALLY AND EXTERNALLY).

Figure 1

GENERAL POTABLE WATER STORAGE CISTERN REQUIREMENTS





NOTE :
BREAK TANK CAN BE MAINTAINED DURING RUN DOWN OF MAIN TANK FROM FULL.

PIPING AND VALVE ARRANGEMENTS FOR BREAK TANK OPERATION
(A) NORMAL RUNNING (B) DURING MAINTENANCE

Figure 2

Distribution pipework

3.36 System schematic drawings with valves numbered and labelled will reduce confusion and save time in trying to identify appropriate isolating valves and other system components. The schematic should be mounted in a frame and displayed in the appropriate plantroom.

The following checks and actions should be carried out to show that:

a the system components show no sign of leakage or corrosion;

b. the system insulation is in good condition;

c. the system filters have been changed and/or cleaned in accordance with manufacturer's recommendations. Regularly check and clean strainers;

d. all isolating valves have periodically been worked through their full range of travel;

e. emergency deluge showers and eye baths are regular (weekly) flushed to prevent stagnation of the water in pipework serving this equipment;

f. every water outlet complies with the backflow protection requirements of the water byelaws.

3.37 A schematic drawing illustrating a hot and cold water services distribution system is included in Figure 3 of this volume.

Temperature control

3.38 The temperature of water stored in cisterns should be maintained below 20°C, as far as is practicable, to minimise bacterial growth. Storage installations should be insulated and protected from thermal gains.

3.39 The temperature of the cold water service should be checked at least twice a year. Tests should include:

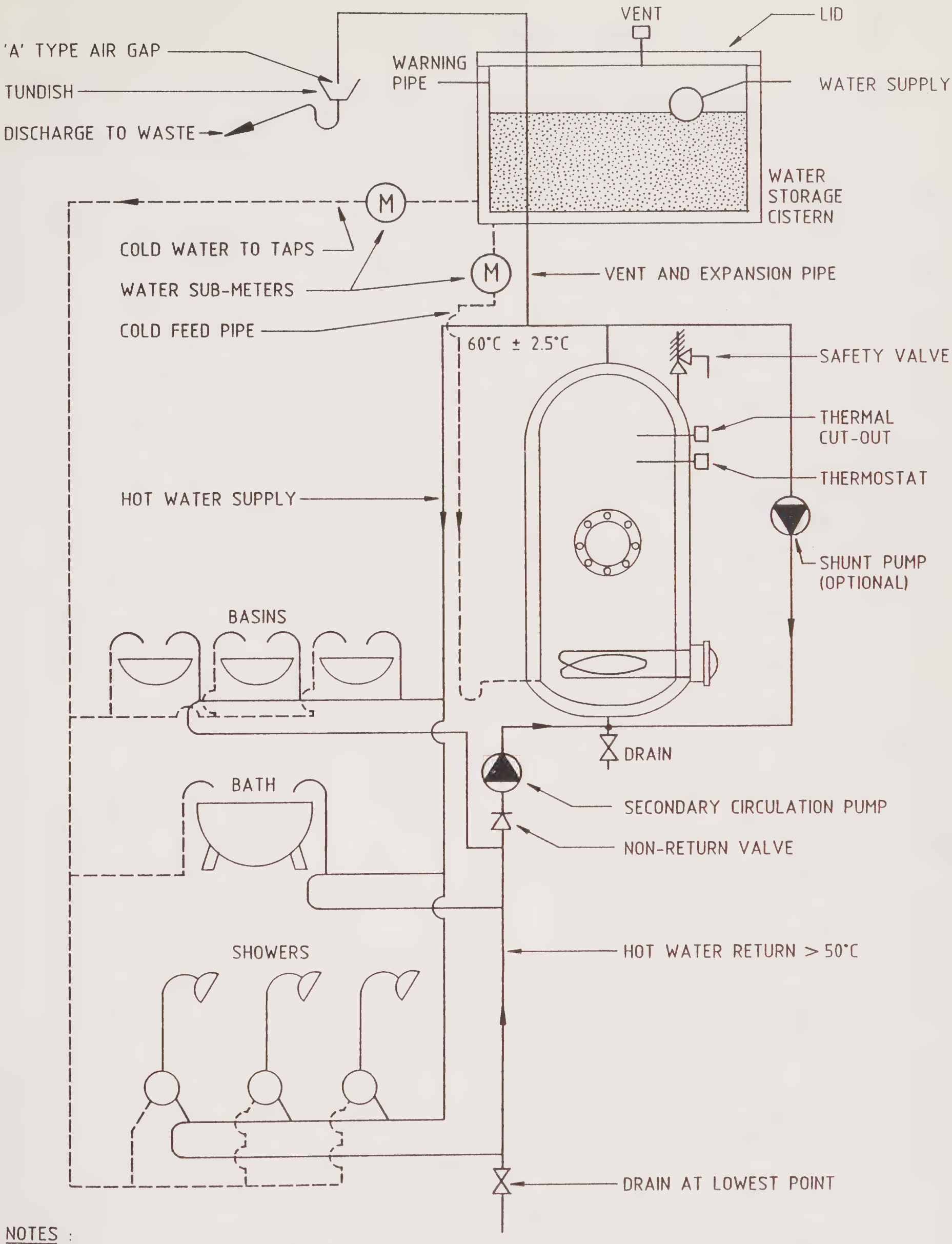
a. measuring the incoming water temperature at the main water meter;

b. testing the inlet, outlet and surface water temperatures of cisterns and cold water feed/header tanks for the hot water calorifiers. The temperature should not be greater than 2°C above that measured at (a);

c. at cold water draw-off points a temperature of not greater than 2°C above the temperature measured in the storage cistern should be reached within one minute of running the water.

Metering

3.40 Where water meters are installed in below-ground meter chambers, ensure the chambers are kept clean of debris and water; this will enable quick and accurate reading of the meters.



NOTES :

1. ALL PIPEWORK TO BE INSULATED.
2. ISOLATING AND CONTROL VALVES NOT SHOWN.
3. ALL DRAINS SHOULD DISCHARGE TO WASTE VIA A TYPE 'A' AIR GAP.

SCHEMATIC HOT AND COLD SERVICES DISTRIBUTION

Figure 3

3.41 Periodically check that meters are actually working and giving accurate readings.

3.42 Meters, other than the water supplier's meters, should be removed at such intervals as recommended by the manufacturers for cleaning and renewal of worn parts and should be tested for accuracy prior to replacement.

Monitoring

3.43 Read meters on a regular basis (monthly) and monitor consumptions; a bar graph will highlight unusually large consumption, which can then be investigated.

3.44 Check the consumption on the utility bill against that indicated by the regular meter readings, and investigate discrepancies.

3.45 Regularly check system components for signs of leakage; a tap left dripping can waste in excess of 14,000 litres of water each year.

3.46 Regular analysis of water samples at six-monthly intervals should be carried out wherever bulk drinking water storage exceeds 1000 l and is supplied from the water undertaker. Supplies taken from local boreholes etc should be tested to comply with the requirement of the Private Water Supply Regulations. Additional checks/analysis should be carried out after any repairs or modifications to the system. The results of all analysis should be kept and recorded.

4.0 Hot water systems

Hot water calorifiers

4.1 Calorifiers should be subjected to regular cleaning and maintenance procedures which include the following:

- quarterly draining to minimise the accumulation of sludge. This frequency may be extended to annual if, during inspection, it is found that there is little accumulation of debris;
- whenever dismantled, for statutory inspection or every year in the case of water/water calorifiers, calorifiers should be thoroughly cleaned to remove sludge and loose debris (it is not essential to remove all scale);
- whenever a calorifier is taken out of service, or its flow temperature falls below 45°C for any reason, it should be refilled, drained, refilled again and the entire contents brought up to and held at the nominal operating temperature of 60°C for at least one hour. A calorifier shunt pump will significantly reduce the heat-up time. The calorifier should remain isolated until the procedure is completed. When bringing calorifiers back on line, it is important that service valves are opened slowly to avoid any disturbance of sedimented debris. Calorifiers which are to be taken out of service for more than a few days should be drained and should not be refilled until ready for return to service. The drain valve should be left open throughout the period the calorifier is out of use;
- users are reminded that if a calorifier is colonised by legionellae and is then drained and opened for maintenance purposes, there can be a risk of infection to maintenance personnel;
- where it is known or established that gross over-capacity exists in a calorifier, and where it is practicable to do so, it should be removed;
- a schedule of approximate calorifier emptying times is included as Table 1.

Hot water circulating pumps

4.2 Circulating pumps should be of adequate performance to ensure a minimum available temperature at draw-off points at 55°C and an absolute minimum of 50°C for the control of, for example legionellae.

4.3 In circumstances where it is impracticable to remove pumps (that is, when leaving the standby pump available for immediate connection into the HWS circulating system), the pumps should be switched daily to ensure that any standby or back-up pump is regularly brought into service as the main duty or lead pump. It may be more effective to utilise an auto-changeover system, in which case more frequent switching would be appropriate.

4.4 It is not permissible to shut down the pumped circulation system. To do so will lead to the loss of the required system temperatures.

Calarofier type	Diameter/length ratio	Capacity litres (gallons)	Drain valve sizes mm (inch)		
			25 (1.0)	38 (1.5)	50 (2.0)
Horizontal	1:2.5	13,500 (3,000)	3 hr 15 min	1 hr 30 min	45 min
		9,000 (2,000)	2 hr 15 min	1 hr 00 min	30 min
		4,500 (1,000)	1 hr 15 min	30 min	20 min
		2,250 (500)	45 min	20 min	10 min
		1,800 (400)	35 min	15 min	9 min
		1,400 (300)	28 min	12 min	7 min
Horizontal	1:1.5	13,500 (3,000)	3 hr 00 min	1 hr 20 min	45 min
		9,000 (2,000)	2 hr 10 min	1 hr 00 min	30 min
		4,500 (1,000)	1 hr 10 min	30 min	20 min
		2,250 (500)	39 min	17 min	10 min
		1,800 (400)	32 min	14 min	8 min
		1,400 (300)	25 min	11 min	6 min
Vertical	1:1.5	13,500 (3,000)	2 hr 45 min	1 hr 15 min	40 min
		9,000 (2,000)	2 hr 00 min	55 min	30 min
		4,500 (1,000)	1 hr 10 min	30 min	20 min
		2,250 (500)	38 min	17 min	9 min
		1,800 (400)	31 min	14 min	8 min
		1,400 (300)	25 min	11 min	6 min

Times assume no hose and simple gate valve.

Notes 1. Ball type valve(s) should be specified to avoid "clogging".
2. The drain from the gully should be of sufficient size to take the flow from the calorifier drain.

Table 1 Emptying times for calorifiers (approx)

Trace heating

4.5 Electrical trace heating should be checked routinely (at least annually) to ensure that it maintains the water temperature above 50°C. Care should be taken to ensure there are no cool spots.

Showers

4.6 Hyperchlorination of shower heads and angle valve strainers has only a short-lived effect on legionellae. Automatic drain valves are ineffective in maintaining a reduction in the number of legionellae in shower water. Regular flushing of showers reduces legionellae. The most effective management of showers will be achieved by the removal of unnecessary ones and the regular use of others.

Temperature control

4.7 During a period of low ambient temperature, check the temperatures of the outflow from the HWS calorifier to establish that the temperature is above 60°C and that the temperature at the return connection is not less than 55°C. The most distant draw-off point on the system should be checked to ensure that the temperature reaches a steady state value between 60°C and 50°C within one minute of running the water at full flow. Appropriate remedial action should be taken where necessary.

4.8 Although the Health and Safety Executive in HS(G)70 recommends spot checks, this guidance requires a temperature excursion limit of less than 20 minutes. There should be no more than two excursions in any 24-hour period; therefore, continuous monitoring is recommended.

4.9 Where there is a building management system, it could be used to monitor temperatures within the system.

4.10 It is essential to check the temperature settings and operation of all water mixing devices routinely, at least half-yearly. Other maintenance should be strictly in accordance with the manufacturer's instructions. The local water quality will influence the maintenance frequency for any installation. A relatively small piece of debris may restrict the operation of the temperature control and fail-safe mechanisms.

4.11 Recommendations regarding safe water and surface temperatures given in NHS Estates' Health Guidance Note – '"Safe" hot water and surface temperatures', apply to all ward accommodation, residents' rooms and those areas to which patients, residents and visitors have free access (including public areas). Until the recommended precautions are put into effect, staff should be made aware of the potential danger and take the necessary steps to protect patients, residents and visitors. Areas which do not meet these recommendations should be identified, and plans to comply as soon as reasonably practicable should be devised.

5.0 Other operational considerations

Hydrotherapy pools, whirlpool baths and spas

5.1 Hydrotherapy pools, whirlpool baths and whirlpool spas provide conditions which potentially favour the growth of legionellae. While there have been no reported cases of legionellae infection implicating hydrotherapy pools, there have been several outbreaks associated with spa pools or whirlpools. These are particularly vulnerable because of the small volume of water in circulation and the multi-occupancy (typically three to six persons) makes an outbreak more likely. Careful maintenance and chemical treatment is essential to maintain water quality. A log must be kept of the treatment, filter cleaning and the results of tests for pH, free residual halogen and other treatment parameters.

5.2 Spa baths and whirlpool baths which provide a single fill for each individual use do not appear to present the same hazard. There remains concern, however, about retention of water in these systems; an International Standard to cover this subject is proposed.

5.3 Regular cleaning and periodic disinfection in accordance with manufacturer's instructions is recommended.

5.4 The Swimming Pool and Allied Trades Association (SPATA) will provide advice on the operation of whirlpool spas.

5.5 All staff who operate/maintain this type of equipment should receive adequate training to ensure that appropriate safety procedures and effective water treatment regimes are adopted.

5.6 Advice on the operation of hydrotherapy pools is contained in 'Department of Rehabilitation, a Design Guide', published by the DHSS in 1974. More recent information is contained in the Central Sterilizing Club's, 'Hygiene for Hydrotherapy Pools', published in 1990 and in the Public Health Laboratory Service booklet 'Hygiene for Hydrotherapy Pools'.

5.7 Maintenance for this equipment should be carried out in accordance with the manufacturer's recommendations.

Temporary closure of wards/departments

5.8 During temporary closure of wards or departments, a procedure for flushing the hot and cold water service systems should be instituted. This should include opening all taps for a period of three minutes and flushing WC cisterns, etc on a weekly cycle. Alternatively, when this is impracticable, the disinfection procedure recommended for new installations may be carried out immediately prior to occupation.

Ice-making machines, water coolers and drinks-vending machines

5.9 Maintenance for this equipment should be carried out in accordance with the manufacturer's recommendations.

5.10 The equipment should be positioned so that the warm air exhaust does not impinge directly on taps or hoses supplying cold water.

5.11 Ensure that the water supply to this equipment is taken from a potable supply. Where equipment is hand filled, there should be clear instructions on the water used. This should be from the mains supply and collected and decanted into the equipment from a clean vessel, and in a hygienic manner.

5.12 Ice should not be allowed to stagnate in an ice-making machine's storage bin, but should be changed frequently.

6.0 Water economy

Leaks

6.1 Monitor consumption; if it increases for no readily identifiable reason, this may indicate a leak. Underground leaks may be identified by:

a. wet or soggy patches of ground;

b. areas of grass that are greener or growing stronger and more quickly than the remainder;

c. water in stop valve chambers.

Cistern flushing

6.2 Ensure that the amount of water used as a result of flushing cisterns complies with the water byelaws.

Other economy measures

6.3 There are a number of other economy measures which may be implemented; these include:

- the fitting of flow restrictors to hand-basin taps, or fitting spray taps;
- proximity detectors and timing devices controlling the flushing of urinals;
- consider replacing baths with showers where this is a practicable proposition–showers use significantly less water than baths;
- minimise dead-legs on the hot service to hand-basins. The cold water in these sections is usually run off to drain while waiting for the hot water to arrive;
- ensure that baths and sinks are fitted with waste plugs to discourage wasteful run-off;
- ensure that systems are adequately frost-protected and well-maintained;
- use posters, etc to raise awareness of the need for water economy and discourage wasteful practices such as leaving taps running. The posters are available from the Department of the Environment.

7.0 Emergency action

7.1 Contingency plans should be available in the event of the following:

a. a power failure affecting distribution/circulating pumps;

b. a mains water failure which could endure beyond the period offered by the storage capacity.

7.2 The following section extracted from HTM 2040 indicates the course of action to be followed if an outbreak of legionnaires' disease is suspected.

7.3 The nominated person will usually be informed of a suspected case of legionnaires' disease possibly associated with healthcare premises by either the infection control team or the local Consultant in Communicable Disease Control (CCDC). If a case is suspected, the hospital outbreak team will normally work in association with the Public Health Laboratory Service and the local CCDC to search for the source of the causative organism. It is essential that systems are not drained or disinfected before samples have been taken. The nominated person's role is an important one – guiding the team to the various water systems within the building and, in particular, to the points from which samples can be taken. Easy access to these sampling points is essential.

7.4 The investigation will concentrate upon all potential sources of legionella infection, including:

- the domestic hot and cold water distribution system including cold water storage systems;
- wet spray cooling-water systems;
- showers or spray-washing equipment;
- drainage systems and traps;
- spas, whirlpool baths or therapy pools;
- humidifiers in ventilation systems;
- cooling coils in air-conditioning systems;
- fountains and sprinklers.

7.5 To assist in such investigations, the nominated person must be able to provide details of all associated equipment, including all documentation. He/she must assist by advising the investigating team on the extent of servicing on the site, and by locating taps and sample points.

7.6 The nominated person must also identify the locations of any medical equipment used for dental care, respiratory therapy and within haemodialysis units, etc.

7.7 Off-site information will also be required, such as whether there have been any local excavation or earthmoving works, alterations to water supply systems or drainage systems, or any other factors which may have a bearing on the site.

7.8 The address and telephone number of the nearest weather station will be required – this is likely to be a local airport, university or college department.

7.9 The team is responsible for identifying the cause of infection, and will advise on cleaning, disinfection, any modifications, and long-term control measures.

8.0 Protection of staff

8.1 All works carried out shall be subject to:

a. the Health and Safety at Work etc Act;

b. the management of Health and Safety at Work Regulations;

c. the Control of Substances Hazardous to Health (COSHH) Regulations;

d. the Water Supply Regulations;

e. the Public Health (Infectious Diseases) Regulations;

f. the Provision and Use of Work Equipment Regulations.

9.0 Responsibilities of maintenance personnel

Designated staff functions

Management

9.1 Management is defined as the owner, occupier, employer, general manager, chief executive or other person who is ultimately accountable for the safe operation of healthcare premises.

9.2 A person intending to fulfil any of the staff functions specified below should be able to prove that they possess sufficient skills, knowledge and experience so as to be able to perform safely the designated tasks.

Infection control officer

9.3 Infection control officer – or consultant microbiologist if not the same person, nominated by the management to advise on monitoring infection control policy and for the maintenance of water quality.

9.4 Additionally the policy should be acceptable to the control of infection committee and any amendment to that policy must be agreed by the committee.

Nominated person

9.5 A nominated person (water), possessing adequate professional knowledge and with appropriate training, should be nominated in writing by management to devise and manage the necessary procedures to ensure that the quality of water in healthcare premises is maintained. The person will be required to liaise closely with other professionals in various disciplines. In addition, the person should possess a thorough knowledge of the control of legionellae and would ideally be a chartered engineer.

9.6 This person's role, in association with the infection control officer and maintenance staff, involves:

a. advising on the potential areas of risk and identifying where systems do not comply with this guidance;

b. liaising with the water undertakers and environmental health departments and advising on the continuing procedures necessary to ensure acceptable water quality;

c. monitoring the implementation and efficacy of those procedures;

d. approving and identifying any changes to those procedures;

e. ensuring that equipment which is to be permanently connected to the water supply is properly installed;

f. ensuring that adequate operating and maintenance instructions exist and adequate records are kept.

9.7 Implementation of an effective maintenance policy must incorporate the creation of fully detailed operating and maintenance documentation and the introduction of a logbook system. The "nominated person" should appoint a deputy to whom delegated responsibilities may be given. The deputy should act for the nominated person on all occasions when the nominated person is unavailable.

9.8 The nominated person should be fully conversant with the design principles and requirements of water systems and should be fully briefed in respect of the cause and effect of water borne organism, for example *Legionella pneumophila*. The appointment of an engineer as the nominated person is appropriate in that the responsibility can extend to the operation and maintenance of associated plant. It is recognised that the nominated person cannot be a specialist on all matters and must be supported by specialists in specific subjects such as water treatment and microbiology, but he/she must undertake responsibility for calling upon and co-ordinating the activities of such specialists.

Maintenance technician

9.9 A person who, in the opinion of the nominated person has sufficient technical knowledge and the experience necessary to carry out maintenance and routine testing of the water, storage and distribution system.

Tradesperson

9.10 A person who is appointed in writing by the nominated person to carry out, under the control of the maintenance technician, work on the water, storage and distribution system.

Installer

9.11 A person or organisation responsible for the provision of the water, storage and distribution system.

Contractor

9.12 The person or organisation designated by management to be responsible for the supply and installation of hot and cold water services, and for the conduct of the installation checks and tests.

Contract supervising officer

9.13 The person authorised by the hospital authority to witness tests and checks under the terms of contract. He/she should have specialist knowledge, training and experience of hot and cold water supply, storage and mains services and HTM 2027.

10.0 Record-keeping

Post commissioning documentation for health buildings in Scotland Scottish Hospital Technical Note 1

10.1 Management should ensure that an accurate record of all assets relating to the hot and cold water distribution systems is set up and regularly maintained. They must also ensure that records of all maintenance, inspection and testing activities are kept up-to-date and properly stored.

10.2 Planned preventive maintenance will help to ensure that systems perform correctly, and an essential element of this process is the maintenance of accurate records.

10.3 Maintenance records are normally required for the following purposes:

a. verification of maintenance for local accountability;

b. verification of maintenance for statutory obligations;

c. as a means of monitoring the maintenance policy and its effectiveness;

d. as a means of observing performance trends, helping fault diagnosis and initiating corrective action where necessary;

e. as an aid to financial planning.

10.4 When alterations to plant or systems are implemented the record drawings should be updated to reflect the modifications carried out.

10.5 An asset register for the engineering services would provide a structure for recording, retrieving and analysing information.

10.6 The following are some of the significant applications of an asset register:

- as a plant inventory;
- to provide a basis for identifying plant details;
- to provide a basis for recording the maintenance requirements;
- to provide a basis for recording/extracting information associated with the maintenance of an asset;
- to provide a basis for an accountant to establish the provision that needs to be made for plant replacement;
- for insurance purposes.

10.7 Further information on the monitoring of performance and effectiveness in carrying out maintenance tasks can be found in CIBSE Technical Memorandum TM17: 1990, 'Building Services Maintenance Management'.

References

Statutory requirements

Health and Safety at Work etc Act 1974. HMSO 1974.

Model Water Supply Byelaws. HMSO 1986.

SI 2051:1992 The Management of Health and Safety at Work Regulations. HMSO 1992.

SI 3246:1994 Control of Substances Hazardous to Health (COSHH) Regulations. HMSO 1994.

SI 2932:1992 The Provision and Use of Work Equipment Regulations. HMSO 1992.

SI 1039:1978 (NI 9) Health and Safety at Work (Northern Ireland). HMSO 1978.

SI 374:1990 (NI 9) Control of Substances Hazardous to Health (COSHH) Regulations (Northern Ireland).

SI 1550:1988 (S.155) Public Health (Notification of Infectious Diseases) (Scotland) Regulations. HMSO 1988.

SI 1147:1989 Water Supply (Water Quality) Regulations. HMSO 1989.

SI 1384:1989 Water Supply (Water Quality) (Amendment) Regulations. HMSO 1989.

SI 1837:1991 Water Supply (Water Quality) (Amendment) Regulations. HMSO 1991.

SI 119:1990 (S.11) Water Supply (Water Quality) (Scotland) Regulations. HMSO 1990.

SI 1333:1991 (S.129) Water Supply (Water Quality) (Scotland) (Amendment) Regulations. HMSO 1991.

SI 2790:1991 Private Water Supplies Regulations. HMSO 1991.

SI 1546:1988 Public Health (Infectious Diseases) Regulations. HMSO 1988.

SI 2932:1992 The Provision and Use of Work Equipment Regulations. HMSO 1992.

British Standards

BS1212:1990 Float operator valves
Part 1: 1990 Specification for piston type float operated valves (copper alloy body) (excluding floats).

BS2871 Specification for copper and copper alloys. Tubes.
Part 1:1971 Copper tubes for water, gas and sanitation *(AMD 1422, 5/74; AMD 2203, 11/76).*

BS6700:1987 Specification for design, installation, testing and maintenance of services, supplying water for domestic use within buildings and their curtilages.

BS6100 Glossary of building and civil engineering terms.
Section 2.7:1992 public Health. Environmental Engineering.
Section 3.3:1992 Sanitation.

Other publications

Health Building Note 25 – Laundry. HMSO 1994.

Health Building Note 13 – Sterile services department. HMSO 1993.

National Health Service Model Engineering Specifications. NHS Estates 1993. (2 vols electrical, 2 vols mechanical).

Post commissioning documentation for health buildings in Scotland (SHTN 1). Scottish Office, HMSO 1993.

Water Fittings and Materials Directory. Water Research Centre, published every 6 months.

Water supply byelaws guide. Water Research Centre, 1989.

Dadswell, J. V. **Hygiene for hydrotherapy pools.** Public Health laboratory Service, 1990.

Guidelines for drinking water quality: recommendations. World Health Organisation (WHO), HMSO 1993.

Maintenance management for building services (Technical Memorandum TM 17). Chartered Institute of Building Service Engineers, 1994.

Standards for commercial spas: installation, chemicals and water treatment. Swimming Pool and Allied Trades Association, 1989.

Hygience for hydrotherapy pools: report of a working party on hygiene for hydrotherapy pools. Working Party on Hygiene for Hydrotherapy Pools, Central Sterilising Club, Hospital Infection Research Laboratories, 1986.

Hejab, M. **Water Treatment for Building Services Systems Application Guide (AG 2/93).** Building Services Research and Information Association (BSRIA), 1993.

Health Guidance Note – "Safe" hot water and surface temperatures. HMSO 1992.

Other publications in this series

(Given below are details of all Health Technical Memoranda available from HMSO. HTMs marked (*) are currently being revised, those marked (†) are out of print. Some HTMs in preparation at the time of publication of this HTM are also listed.)

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81	Supp 1 1993.
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